

Accreditation of UG Engineering Programmes in India: Enhanced Role of Teaching Fraternity

Suresh D. Mane¹

¹ Professor, Dept. of Mechanical Engineering, Shaikh College of Engg. & Technology, Belagavi 591556, Karnataka, India

Abstract

The Indian engineering education has grown leaps and bounds in the recent years. National Board of Accreditation was constituted in 1994 under AICTE to look into the quality assurance aspect of engineering education. Since 2012, NBA has constantly updated its SAR and come out with three different Self assessment reports to evaluate the technical institutions under tier II category with the total marks being unchanged at 1000. In 2012 NBA had 10 different criteria's, thereafter in 2013 January NBA revised its criteria's to 9, and once again in June 2015 NBA has come out with final SAR having 10 different criteria's for accreditation of tier II institutions. It is observed that NBA has consistently increased the marks under criteria number 5 faculty contributions from 150 in 2012 to 175 in 2013 and now recently to 200 marks which now constitutes 20% of the total marks and is the largest criteria. This study looks into the facets of criteria number 5 as they have developed over the years and a comparative table has been created. Deliberations were undertaken with faculties from various NBA accredited engineering institutions as well as institutions strongly aspiring for the coveted certification. Due to frequent changes in the criteria's the teaching faculty are not clear about the criteria's and their role in changing scenario. The various measures the teaching faculties need to keep in mind for ensuring greater contribution and better score in accreditation process has been enumerated enlisted to enlighten the teaching fraternity.

Keywords: OBE, NBA, Faculty Information and Contribution, UG Engineering Programmes

1. Introduction

Outcome based education (OBE) is catching up in India in the recent decade and due to increased access to information, more and more institutions are aspiring to get their programmes accredited by National board of Accreditation (NBA) for the

associated benefits (1). Accreditation is the formal recognition of the quality of an educational program / Institution by an external - independent agency on the basis of impartial assessment on the basis of well defined criteria (2). NBA was constituted in 1994 under AICTE Act (All India Council for Technical Education) to provide for accreditation of technical educational institutions and has become an autonomous body since January 2010 and looks into quality assurance of technical programmes. NBA was a provisional member of Washington Accord (WA) since 2007 and became a full signatory in 2014 (3). The WA was signed in 1989 and it is an international agreement among bodies responsible for accrediting undergraduate engineering degree programs and over 20 leading nations in the world are signatory to the same as on January 2015. WA recognizes the substantial equivalence of programs accredited by those bodies and recommends that graduates of programs accredited by any of the signatory bodies be recognized by the other bodies as having met the academic requirements for entry to the practice of engineering. OBE is a novel way to improve the delivery of engineering education as it has a paradigm shift from the classical teaching focus to the focus on student outcome. OBE is a wholesome concept which focuses on the 12 attributes the graduate engineer needs to possess after matriculation from the programme (4).

Engineering education is challenging for students as well as teachers for a number of reasons (5). For students, the reasons being new university environment, new engineering curriculum, teaching and learning styles and socio-cultural influences. For teachers, the reasons may include having to teach students with diverse socio-cultural background and weak analytical ability, changing technological curriculum and its relevance to industry, and financial constraints. The faculty needs to understand the following various criteria's for effective course delivery (6). Continually attempts to improve the course delivery by updating the content and/or

making use of new instructional materials and methods (including ICT) (7). To assist the accreditation process the PO have been broken into set of outcome elements (8). Technical education today needs total revamping and changes needs to be introduced in the various sub components of the system (9, 10). Empirical studies show that there is greater need for student engagement to make engineering education meaningful (11). India has 3400 engineering colleges with a capacity to accommodate 15 lakh students (12). Hence it's imperative that the institutions and faculty gear up to implement OBE for a better tomorrow.

NBA basically accredits technical programmes in India where as National Accreditation and Assessment Council (NAAC) accredits institutions. Programme refers to a course such as Bachelor in Mechanical Engineering (B.E. Mech.) or Masters in Energy Systems Engineering (M.Tech. Energy Engineering). NBA has two tier programme for accreditation: Tier I for Institutes such as IIT, NIT, Central/State/Private/Deemed to be Universities and autonomous colleges. Tier II institutions are colleges under government/government aided/private self financing which are controlled and affiliated to universities. The accredited tier I programmes are now globally recognised as equivalent to the ones offered by nations like US, UK etc which are signatory to the WA. Accreditation has evolved over time from prescriptive to input output model and now to outcome based model. Earlier prescriptive model was minimalistic in nature that provided prescription for minimal case and specifies general parameters like student faculty ratio, courses, internship, checklists (13). Present outcome based assessment based accreditation believes in continuous improvement and on having direct measures in terms of PO. It checks the student's knowledge, skills and behavior, teaching effectiveness, research impact on outcome attainment. Rubrics are also used for assessment under OBA. Rubrics are assessment devices to analyse soft outcomes (perceptual data) which cannot be interpreted by hard data. PO such as engineer and society, communication need rubrics for assessment. Rubrics are of two types holistic and analytical. Teacher starts with holistic model and refines it to get meaningful analytical model. Rubrics contains 3 components i.e. dimension (performance criteria), scale for level of performance and descriptors.

2. Designing for NBA accreditation

The institution needs to first come out with a vision for itself and accordingly have various missions to achieve the mission. Vision is a futuristic statement (dream) that the institution would like to achieve over a period of time and mission (few statements) are the means by which the institution proposes to move towards and achieve the stated vision. Considering the view points of all the stakeholders' viz. the faculty, students, employers, alumni, parents, management the programme educational objectives are formed which act as a guideline for the particular (PEO) programme. These PEO are few in number say 4 to 6 which broadly describe what knowledge, skills and behaviour the graduate engineer needs to attain after few (3-5) years of graduation. The PEO should be in line with the mission and thus the vision of the institution. After the PEO are formulated the programme outcomes (PO) are described. PO are 12 in number and represent the graduate attributes as described under WA. For each subject we need to define unit wise/chapter wise objectives and them correlate them to arrive at objectives for the subject known as course outcomes. The course refers to subjects studied in each semester and hence the course outcomes (CO) need to be defined for each and every subject. CO indicates the learning outcomes in terms of knowledge, skills and behaviour after each semester. After the top down approach of defining and designing the outcomes is over mapping is to be undertaken. Mapping is the process of representing, preferably in matrix form, the correlation among the parameters. Mapping shows what desired outcomes are already taught, and at what level, reveals gaps, reveals potential for cross-course collaboration. Mapping makes course, program level outcomes clearer to the students and shows where interventions may be required. Mapping is undertaken to correlate the Mission with PEO, PO to the PEO and the CO to the PO. How the course outcomes contribute to the attainment of the programme outcomes, how the PO lead to fulfilment of PEO needs to be explained by use of tables and charts. The correlation can be low/medium, high or not applicable (ranked 1, 2, 3 or “-“respectively) as the case may be. In the new 2015 SAR 12 POs are already defined and the CO does not map the entire PO. Hence augmentation process needs to be undertaken to ensure that the entire 12 PO are

mapped and thus the PO viz. lifelong learning, professional ethics, engineer and society can be fulfilled. The vision, mission and PEO should be given wide coverage and brought to the notice of all stakeholders. In 2015 SAR programme specific outcomes (PSO) have been included which are specific to the programme and institutions need to come out with couple of PSO. The attainment of CO, PO, PSO and PEO needs to be demonstrated by the students in the three consecutive preceding years and supporting records need to be maintained by one and all concerned for all the 10 criteria's and the 50 odd subcriteria documents need to be designed, created, implemented and maintained.

2.1 Role of Teaching Fraternity

Teaching faculty in engineering institutions undertake numerous tasks related to the programme such as preparation of lesson plan, assignments, PPT's, lecture notes, lab plans, internal assessment question papers etc. Apart from preparation they need to have effective and efficient delivery of the content to the students on a day to day basis in class rooms as well as laboratories. Then comes the assessment of the students learning by way of tests both internal and external, assignments or by verbal questioning, quiz programmes etc.

Every semester academic calendar is prepared by the educational institutions as per the university notification regarding commencement and conclusion of semester. The teaching faculty prepares the academic time table for all the classes as per the academic calendar. Moreover co- curricular activities such as industrial visits, conferences, workshops, faculty development programmes also need to be taken care of while preparing the time table. Extracurricular activities such as sports competitions, annual day celebration, welcome to fresher's, farewell to final year students needs to be planned in the time table. Days of national importance such as Independence day, Republic day, Engineers day, Teachers day, and Graduation day also need to be cited in the academic calendar.

Teachers need to prepare own notes annually and keep updating the same referring standard text books. The quality of question papers for internal evaluation needs to be standardised to meet the CO and also the scheme of evaluation need to be maintained for all internal assessment tests. The necessary records of results in both internal assessment as well as end of

semester exams need to be maintained for evaluating the achievement of CO. It is recommended that the unsolved questions from standard text books be given as assignments to students.

2.2 Need for Standardised Syllabus and Text books / Reference books

Various universities are having common programmes with large variations in subjects and credits. AICTE needs to come out with basic set of subjects and the concerned laboratories for these programmes. It is observed that many an accredited autonomous institutions have undertaken major overhaul of the subjects to favour the students to achieve higher and better success rates.

Lesson plans for theory subjects and lab plans as per time table need to be prepared by individual faculty to ensure adequate time for course delivery and its successful completion. Faculty needs to go through the standard text books and reference books to prepare hand written notes to ensure the subject is understood by the students. Fortunately today lots of books are available on the engineering topics both in printed form as well as E copies. It is seen from my personal teaching experience that most of the engineering text books by native authors do not dwell much on real world application or examples when compared to the foreign authors. Indian authors give very brief introduction about the topic and mostly focus on the numerical part solving various sorts of questions. Some authors have gone to the extent of writing the text books as per the syllabus prescribed by the university to ensure that it is helpful to the student fraternity. This situation is not helpful in advancement of knowledge as students end up cramming the formulae just before the examinations without understanding their role or significance. Different authors use different notations and hence for want of standardisation of notations the students and even the faculty at times get confused about the problems.

Table 1: Marks awarded to various criteria under SAR

NBA March 2012 Manual for Accreditation		NBA 2013 January Manual		NBA- SAR 2015 June (Tier II)		
Criterion	Mark	Criterion	Mark	Criterion	Mark	
Student Teacher Ratio	20	Student Teacher Ratio	20	Student Teacher Ratio	20	
Faculty Cadre Ratio	20	Faculty Cadre Ratio	20	Faculty Cadre Proportion	25	
Faculty Qualification	30	Faculty Qualification	30	Faculty Qualification	25	
Faculty Retention	20	Faculty Retention	15	Faculty Retention	25	
Faculty Research Publication	20	Faculty Research Publication	20	Research and Development Academic Research 10 Sponsored Research 05 Development activities 10 Consultancy from Industry 05	30	
Faculty Intellectual Property Rights	10	Faculty Intellectual Property Rights	10			
Funded R&D projects and Consultancy Work	20	Funded R&D projects and Consultancy Work				
Faculty Interaction with outside world	10	Faculty Interaction with outside world	10			
MEASURES INTRODUCED IN JANUARY 2013	IN	Faculty Competencies relating to programme Specific Criteria	15			
		Faculty in FDP/ Training	15	Faculty as participants in FDP/ Training	15	
	MEASURES INTRODUCED IN JUNE 2015				Innovation by the faculty in teaching and learning	20
					Faculty performance appraisal and development system	30
					Visiting/Adjunct/ Emeritus faculty	10
TOTAL POINTS	150	TOTAL POINTS	175	TOTAL POINTS	200	

Many a times due to want of slot the theory and allied laboratory are not included in the same semester and as such the learning is not up to the mark for want of coordination. To cite an example

for Applied Thermodynamics (ATD) subject being taught in Mechanical Engineering IV Semester under Visvesvaraya Technological University (VTU) which has IC engines chapter, there is no corresponding laboratory in IV semester. This puts extra burden on the faculty to simplify the topic to enable the students to understand. Table 1 below gives the marks allotted to faculty contributions by NBA in their SAR documents in the past three revisions.

It is strongly felt that the books should be correlated to standard handbooks like ASME, ASHRAE, ASTM and the notations standardised by all the authors. Even universities can promote publication of standard text books based on the handbooks to ensure quality of teaching material is made available

The pie diagram of absolute marks for the various sub criteria's under criteria no 5 faculty information and contribution is as shown in figure 1.

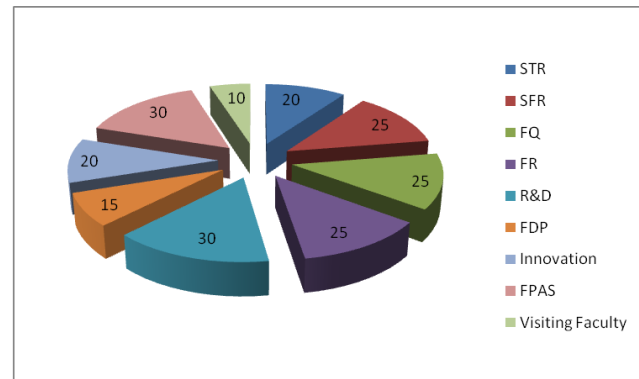


Figure 1. Marks awarded to various sub criteria under final SAR as on June 2015

Following inferences can be made from the table number 1 and figure no 1.

The marks allotted to faculty contribution under criteria number 5 has consistently increased from 150 to 175 and now 200 out of the total marks which remains fixed at 1000 clearly showing the growing importance of faculty contributions.

There is gradual increase in the sub criteria's since 2012. It was 8 in 2012 and increased to 10 in 2013 and 9 in 2015 SAR.

Faculty as a resource person/ participant in FDP/training has been included in 2013 with 15 marks weightage.

Faculty competencies correlating to programme specific criteria have been introduced in 2013 with weightage of 15 marks.

During 2015 criteria 5.7 Research and Development includes Research Publications, Ph. D guidance, Sponsored Research, Consultation from Industry as well as the Development activities. Academic research gets 10 marks, Sponsored research gets 5 marks, Developmental activities get 10 marks and Industrial consultancy gets 5 marks

To encourage Innovation by the faculty in teaching and learning 20 marks have been allotted. This shall result in faculty developing expertise for effective implementation of curricula. Effective, efficient and engaging instruction shall result in contributing to students learning. The innovations need to be recorded, made available on college website.

Faculty performance appraisal and development system with 30 marks has been introduced as an effective performance appraisal is vital for optimising the contribution of individual faculty to institutional performance.

Visiting/Adjunct/ Emeritus faculty with 10 marks has been introduced to include industry experts, retired professors. These long interactions shall throw light on the real world and be effective for students learning.

NBA during June 2015 has come out with SAR format for Tier II UG engineering programmes which is more wholesome and comprehensive in nature. The teaching learning process under section 2.2 gets 100 marks which focuses on process to improve quality of teaching, quality of project reports, quality of internal semester question papers, assignments and evaluation. There is focus on industry interaction to improve the quality of teaching learning and some universities have included internship / summer training in their curriculum.

2.3 Road Map ahead for faculty

The road map can be segregated into three main categories viz. Student Centric activities, Industry related activities and other activities. In addition to the regular duties the faculty needs to undertake the following activities.

2.3.1. Student Centric activities

Undertake research guidance for doctoral students

Prepare students for competitive exams like GATE, CAT, GRE, IELTS, NET, TOEFL etc.

Guide the students to undertake the manufacturing of the project in the college premises making use of the available assets duly procuring the needed consumables and other components from outside.

Form professional bodies such as IE India, ASME, ASHRAE, ISHRAE, SAE, and ISTE students forums and encourage student participate in professional societies activities.

Encourage and guide students to participate in paper presentations, technical competitions in other technical institutions. Maintain documents for assignments, IA tests, mid and end semester examinations results, evaluate the same to obtain academic performance index and student success rates.

2.3.2 Industry Centric Activities

Develop liaison with industries for inviting industry experts as guest lectures

Interact with industry and offer consultancy to improve safety/productivity, reduce energy consumption,

Interact with institutes of national importance, research organisation and industry to obtain research projects

Liaison with central and State PSU's, industries Large/medium/Small scale for in plant training of students.

Look out for project opportunities for final year students which can be collaborative projects with the local industries.

2.3.3 Other activities

Maintain record of innovations and use of Information & Communication Technologies (ICT) adopted such as PPTs, Animated Video Clips, NPTEL videos, E Notes, Working models procurement, Wall Charts, Collaborative teaching, Visit to relevant labs, Visit to relevant industries, Mini projects by students

Maintain proper records of student's performance on regular basis to track their performance for effective mentoring and evaluation of attainment of PO's.

A daily work diary and academic diary covering all the activities can be developed to capture the works undertaken.

Get acquainted with feedback systems such as course feedback, graduate exit feedback, alumni feedback, industrial feedback to evaluate attainment of POs, PEO's and GA's.

Maintain records of contributions to institution which shall help in his own performance appraisal

Develop contacts with retired professors to involve them as adjunct faculty/ Professor Emeritus for difficult subjects

Undertake research and publish the findings

Keep track of the latest developments in his/her field of interest by attending conferences/ workshops/ FDP. Join professional bodies such as IE India, ASME, ASHRAE, ISHRAE, SAE, ISTE, Tribology Society of India, and Indian Society for Heat and Mass Transfer and actively participate in their activities.

Be in touch with the new developments in mechanical design and analysis software's and arrange for invited talks, workshops on these topics.

Undertake funded STTP, self financing STTP, and FDP on recent developments in their areas of interest. Signing MoU with Deshpande Foundation Hubli for leadership development programme for students as well as to develop Entrepreneurship qualities among the students should be enhanced.

Conduct annual alumni meet as well as parents teachers meet every semester.

Look out for opportunities for funded research from central agencies such as UGC, AICTE, DST, DRDO, and from state agencies viz. KSCST, VGST, NAIN. Foreign institutions too are supporting R&D projects and can be approached for funding.

The course has clearly stated measurable learning objectives and contributes toward published POs. The assignments are tied to the CO and are fair, valid, and reliable and the students achieve the learning objectives. Develop appropriate expertise in the course subject and integrate teaching with research. Communicate high expectations of students and a belief that they can meet those expectations, interacts extensively with them inside and outside class, conveys a strong desire for them to learn and motivates them to do so. Provide quality education in the true and broadest sense of the word, not just knowledge of technical content

Conclusions

At the outset NBA needs to be complimented for having brought out the accreditation manual and efforts to come out with excellent and meticulously documented SAR. These criteria's do provide the necessary direction to institutions and the stakeholders to proceed in right path to ensure that the graduate attributes are imbibed in the fresh graduating engineers.

Interactions revealed that the faculties are finding it difficult to understand the various terminologies and issues such as mapping and rubrics adopted for proper documentation. This paper is an attempt to compile the teacher's contribution to ensure better contributions to the institution to facilitate NBA accreditation.

Acknowledgements

The author would like to thank the faculty members of RVCE Bangalore, BVB CET Hubli, HIT Nidasoshi, BEC Bagalkot all in the state of Karnataka and Dr. J.J. Magdum CoE Jaysingpur Maharashtra for their valuable time and inputs.

References

- [1] NBA March 2012 Manual for Accreditation of UG engineering programs
- [2] OBE PPT by Dr. D.K. Paliwal, Dr. A. Koteswara Rao, Dr. S. Bhaskar, Dr. A. Abudahir and Dr. S. Rajakarunakaran
- [3] NBA June 2015 Self Assessment Report (SAR) Format for UG engineering programs
- [4] Accreditation and Quality Assurance: PPT by Surendra Prasad Chairman NBA
- [5] M.A. Satter and J. Pumwa , " Some Problems And Measures for Improving Mechanical Engineering Education at the PNG University of Technology", Proceedings of the 2002 American Society for Engineering Education Annual Conference & Exposition
- [6] Richard M. Felder et. Al, "The Future Of Engineering Education Vs. Assessing Teaching Effectiveness and educational scholarship", Chem. Engr. Education, 34(3), 198–207 (2000).
- [7] Washington Accord: Overview pdf accessed on 6.5.15: www.ieagreements.org
- [8] Kotturshettar B B, (2015), "Defining the performance indicators: A framework for Program

outcomes Attainment”, ICTIEE 2015 proceedings pp 99-102

[9] Tulsi P k, “Expectations of Industry from Technical Graduates: Implications for Curriculum and Instructional Processes”, ICTIEE 2015 proceedings pp 458-463

[10] P Venugopal Reddy, “Engineering Education: Challenges, Threats and Opportunities”, ICTIEE 2015 proceedings pp 599-603

[11] Suresh D. Mane, S P Dodamani, “Measures to improve UG engineering education: An empirical study in the state of Karnataka”, The IJES Vol. IV, Issue IV, April 2015 pp 40-46

[12] World Bank: Report No 57, Engineering Education in India- April 2013, Executive Summary- pp IV

[13] Datta Dandge and Suhasini Desai, “Rubrics: An effective assessment tool for outcome based accreditation”, The Journal of Engineering Education, Jul 2013 pp 14-21.

Dr. Suresh D. Mane passed out BE in Mechanical Engineering from Karnatak University Dharwad in 1991. He joined S.C. Railways and served the organization till September 2012 when he took voluntary retirement to join academics. He completed M.Tech in Energy Systems Engineering from BVB College of Engineering Hubli Karnataka in 2007 duly securing rank to the university. He enrolled for research in UBDT College of Engineering Davangere and was conferred with Doctorate by Kuvempu University Shankarghatta, Karnataka in 2015. He is on editorial board / reviewer for dozens of open access peer reviewed international journals and is Member Institute of Engineers (India) and life member of Indian Society for Technical Education. He has published 8 papers in international journals, one book chapter in Springer and presented papers in 20 conferences/ workshops. His research interests include thermal engineering subjects, energy efficiency, energy management and engineering education. He is also a BEE certified energy manager and energy auditor (EA -8061).